

ETSA Utilities

Delivering energy to South Australians

**ETSA Utilities, ABN 13 332 330 749,
a partnership of:**

CKI Utilities Development Limited,
ABN 65 090 718 880.

HEI Utilities Development Limited,
ABN 82 090 718 951.

CKI Utilities Holdings Limited,
ABN 54 091 142 380.

HEI Utilities Holdings Limited,
ABN 50 091 142 362.

CKI/HEI Utilities Distribution Limited,
ABN 19 091 143 038.

each incorporated in The Bahamas

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CONSTRUCTION STANDARD

FOR

UNDERGROUND CABLE NETWORKS

Technical Standard TS-087

Issue: March 05

1. DEFINITIONS

Inspector	An authorised ETSA Utilities officer appointed to inspect the Works.
Design Drawings	Design drawings are those containing the electrical reticulation layout of the subdivision.
ETSA Utilities	The term "ETSA Utilities" means :- ETSA Utilities, ABN 13 332 330 749, a partnership of: CKI Utilities Development Limited, ABN 65 090 718 880. HEI Utilities Development Limited, ABN 82 090 718 951. CKI Utilities Holdings Limited, ABN 54 091 142 380. HEI Utilities Holdings Limited, ABN 50 091 142 362. CKI/HEI Utilities Distribution Limited, ABN 19 091 143 038. each incorporated in The Bahamas. 1 Anzac Highway, Keswick, South Australia, 5035.
Works	The works involved in the design and construction of the connection assets and the extension in accordance with the specification.

2. RESPONSIBILITY OF THE APPLICANT

The Applicant shall be responsible for the following:

- (a) Carrying out and co-ordinate all the pegging for all equipment, trenching, excavation for cable vaults, bedding sand beneath and above cables, backfilling, reinstatement, levelling, draining of easements, permanent retaining walls and associated work necessary for Contractors to install its cables, transformers and switching stations, service pits and lighting columns.
- (b) Easement provisions in accordance with the Easement Standard for Distribution Networks. TC 102
- (c) Complying with the relevant ETSA Utilities' Standards.
- (d) Providing ETSA Utilities with the relevant authority's written approval for lighting designs and the acceptance of tariff charges.
- (e) Providing ETSA Utilities on completion of the work the following:
 - (i) Written advice that the works are complete.
 - (ii) Test Reports
 - (iii) Access Permit clearance where a Permit has been issued by ETSA Utilities.
- (f) Ensuring kerbs are in place and base coarse as a minimum has been installed on road reserves and the site preparation is suitable for cable installation works.

3. LICENSING OF THE CONTRACTORS AND SUB-CONTRACTORS

All Contractors, Sub-Contractors engaged by the Applicant for the installation of the Works shall be licensed as a Registered Electrical Worker in accordance with The Plumbers, Gas Fitters and Electricians Act 1995, for the relevant endorsements of "Limited to works on overhead lines" or " Limited to cable jointing and underground distribution systems up to consumers terminals excluding (or including) lead".

4. PADMOUNT TRANSFORMER STATIONS AND SWITCHING CUBICLES

4.1 Footings

Concrete footings for padmount transformers and switching cubicles shall be either cast in situ or precast in accordance with ETSA Utilities URD Manual. In certain instances, ETSA Utilities may specify either footing design.

4.2 Locking Facilities

Padmount transformers and switching cubicles are equipped with locking facilities (without padlocks). Doors must be locked when the equipment is not being worked on. Where the Certificate of Practical Completion has been issued by ETSA Utilities, ETSA Utilities will return all padlocks to the Contractor.

4.3 Labels on Cable Circuits

At transformers, labels are required on all cable ends to indicate circuit names or destinations. Labels must be durable, permanent and weatherproof. The labels should be checked to determine whether they are in the correct position and all cable ends are correctly designated.

4.4 HV Fusing

Certain transformers and switching cubicles require high voltage fusing. Where HV fuses are required, they shall be provided by ETSA Utilities at the cost of the Applicant. Fuses will be installed by ETSA Utilities at commissioning. Fuses shall be safely stored within the transformer or switching cubicle.

4.5 Installation

Where a retaining wall is required, a padmount transformer or switching cubicle must not be installed on site until the retaining wall has been constructed and earthworks completed. Refer to TS-085.

5. PREPARATION FOR CABLE INSTALLATION

The ends of cables on drums shall be effectively sealed. If a defective cable end seal is apparent, the cable shall not be installed until all cable affected by moisture has been removed.

Where cables are to be installed in conduits, care shall be taken that stones or other injurious particles are not drawn into conduits by the cables either by adherence to surface of the cable or by the motion of the cable to the conduit entry. Suitable "bell mouths" shall be used at the cable entry ends of conduits to prevent ingress of soil.

A trench and conduit installation is a component of the electrical works and the works. Prior to the installation of any cable in either an open trench or pre installed conduits, the installer should inspect the civil works to ensure that the cable installation will satisfy ETSA Utilities standards. Refer to TS – 085 for further information. Any civil works that are not appropriate may prevent ETSA Utilities accepting the “Certificate of Practical Completion” and undertaking the final connection.

If any part of the Works are sealed in an enclosure, covered up or buried prior to being inspected the Compliance Coordinator can request that the works be uncovered to enable inspection and testing to be undertaken. Refer to the Terms and Conditions for an External Contractor, section 5.4 to 5.7

6. INSTALLATION OF CABLE

6.1 General

Cable drums shall not be transported in any other position than vertical.
During the installation and jointing, cables must not be stood on.

6.2 Cable Drum Operations

The cable may be laid by mounting the cable drum on jacks or trailer or suitable stand, at the end of the trench, fitting a cable stocking grip to the end of the cable and drawing it off the drum into the trench.

When cables are pulled into conduits the cable drum shall be positioned so that the cable is drawn from the top of the drum in an even curve into the required conduit without undue pressure on the mouth of the conduit.

The inner end of the cable is normally housed in a slot incorporated in one flange of the cable drum. The inner end of the cable must be withdrawn from that slot to enable slack cable within the drum to work free without causing internal buckling of cable layers.

At no time must any loose turns on the under side of the cable drum be permitted to come in contact with the surface upon which the cable drum support has been mounted

6.3 Cable Pulling

Where bends in conduits are encountered in a run, the cables shall be lubricated with a cable pulling lubricant, supply item # OC8050, to facilitate drawing in. Petroleum based products are not acceptable. During installation operations, cables, both 11 kV and low voltage, must not be bent to a radius of less than 12 times the overall diameter of the cable. These conditions shall be strictly adhered to, particularly where cables turn into road crossings, conduit entry, etc.

Rollers must be used where cables are installed in an open trench using a pulling rope and eye, cable rollers are to be used at frequent intervals to support the cables and must never be more than 3 metres apart. Care must be taken to ensure that the cable **does not** enter or leave the rollers at an angle that exceeds the bending radius of the cable.

The rollers are to be placed securely to prevent movement. Before driving any spikes to secure the rollers, care must be taken to avoid other utilities' equipment, which may exist below. The pulling rope must be equipped with a swivel and be attached to the cable by a stocking grip with pulling eye.

The plant used to pull cable shall be firmly anchored, before the pull commences, to stop the winch from moving with subsequent uneven pulling of the cable. The cable shall be drawn into the trench smoothly with a minimum of stops and at an average speed of between 9-12 metres per minute, to avoid irregular movement.

The maximum pulling tension when installing cables by mechanical equipment using a stocking grip shall not exceed the figures in the following table.

Cable	Tension (kN)
35 mm ² Al. 4 core bundled 0.6/1 kV	5.6 on all 4 cores
150 mm ² Al. 4 core bundled 0.6/1 kV	24.0 on all 4 cores
35 mm ² Al. single core 6.35/11 kV	2.2
95 mm ² Al. single core 6.35/11 kV	3.4
300 mm ² Al. single core 6.35/11 kV	5.9
630 mm ² Al. single core 6.35/11 kV	8.9

All cable ends must be temporarily sealed by the use of caps secured with electrical tape after cable laying. This requirement applies to 11kV cable and LV cable at all service pit positions.

Where it is required to bury the sealed cable ends, the bare cable sheath must be protected with two heat shrink caps, applied separately. 11kV cables must not be energised with this method of cable end seal.

At the conclusion of a cable pull, all cable ends shall be sealed prior to those ends being secured to the inner and outer drum flange. The sealing of cable ends must be butyl rubber plus insulation tape wrapping as a minimum.

Rollers shall be placed in such locations that may be subjected to heavy rubbing by the cable. Pulling speeds of not greater than 8 metres per minute only may be used for pulling cables into conduits. 11 kV cables are not to be pulled into conduits in which there has been installed low voltage cables and vice versa.

7. CABLE JOINTING

7.1 General

In HV cable installations the number of cable joints must be kept to a minimum. All proposed HV joints must be shown on the design plan and approved prior to installation.

7.2 Site Preparation

The jointer must ensure that the joint bay or location where work on cables is to be performed, is not filled with water and the joint or termination can be completed without being contaminated by foreign matter.

If necessary, the joint bay sides shall be covered with tarpaulin sheets to prevent foreign matter from falling on the joint during the jointing process. Moisture contamination from rainfall must be prevented by providing a cover over the joint bay.

7.3 Working Under Induced Voltage Conditions

Where the metallic sheath or conductors of a cable may be subjected to induced voltage conditions, the jointer shall joint in accordance with the procedures laid down in ESAA Guide D(b) 26-1981 "Guide to Working on Cables and Ancillary Equipment Under Induced Voltage Conditions".

7.4 Conductor Preparation

All bare aluminium cable ends and mating surfaces must be wire brushed and greased with compound containing zinc oxide, prior to the fitting of compression connectors. Refer to E1010 for details.

Greasing of bolted connections is essential to prevent the ingress or corrosive elements and oxidation of the conducting surfaces. Connections in the underground network which require greasing include the following:

- (a) Neutral link connections
- (b) Fuse connections plus contacts
- (c) Bolted aluminium lug faces and aluminium lug to tinned copper switchgear or link terminals
- (d) Aluminium compression lug and link barrels
- (e) Bolted aluminium to tinned copper lug faces
- (f) Bolted aluminium lug to aluminium plate.

Shell Alvania R3 or equivalent grease shall be used for connections (a) and (b). Alminox or equivalent conducting compound with zinc powder particles shall be used for connection (c) (d) (e) and (f). After the application of Alminox to the conductor and lug face, wire brushing shall be performed (wet brushing).

Once compressed, all aluminium connectors and lugs shall be inspected for sharp protrusions, which must be removed with a file. All connectors and lugs shall be de-greased with a solvent.

7.5 Jointing

XLPE insulated cables should be examined for signs of moisture on conductors or discolouring of copper screen wires. If moisture contamination is discovered, the affected cable shall be removed and new cable installed. A report shall be submitted to ETSA Utilities prior to jointing.

Joints and terminations shall be completed as per the relevant drawings and instructions of the URD Manual.

Cable ends shall be adequately supported during the installation of an 11kV straight joint. If the joint is required to be moved to its final position after jointing, it must be re-heated with a gas flame to relax any internal pressures after so moving.

7.6 Terminated But Not Energised HV Cables In A Transformer

This procedure is applicable to a terminated but not connected cable for the following:

- A live ETSA transformer.
- A transformer that is still under the control of the contractor.
- A transformer that is not energised and under the control of ETSA Utilities.

1. Bolt the cable screen to the earth bar.
2. Seal open ends of the load break elbows with a waterproof plastic bag on each phase ensuring that the capacitive test point is left exposed.
For DIN profile dead break elbows utilise two basic insulating plugs and caps (BIP's RN 5440) per dead break elbow and join with the supplied M16 stud. Cover one of the capacitive test points with the cap in the kit and the other with a cap if available or a waterproof plastic bag.
3. Clamp each phase to the earth bar using loop clamp RN26XX (refer E1991 sht. 3.3).
4. Ensure the insulated bushing caps with discharge leads are installed on all spare transformer bushings.
5. Install a warning sign "Do Not Operate" with a zip tie that feeds through and links all three elbows.
6. Install destination labels on all phases.



7.7 Capped HV Cables

7.7.1 Buried 11kV XLPE 35mm² & 95mm² cables

Where any high voltage cable is capped and buried the following must be undertaken;

1. Utilise cable pit as per E1926
 2. Cut the cable 450mm above ground level and remove outer sheath.
 3. Expose 50mm of the core.
 4. Grease the core with jointing compound and fold screens parallel to the cores. Install a stainless steel 12mm hose clamp at the start of the exposed core and over the screen and tighten. Ensure the screen wires have maximum contact with the core.
 5. Bend the screen wires over the hose clamp and cut off the excess core.
 6. Wrap the exposed core and screen in butyl rubber and apply insulation tape over the butyl rubber.
 7. Roughen the outer sheath with emery paper and install a heat shrink cap. For 95mm² cable the 300mm² cap may be required.
 8. Bend the cable and push the capped end into the base of the caisson.
 9. Install destination label on the cable at the top of the bend / pit.
- Note: When the cable is ultimately straight jointed the bent section MUST be discarded as the radius of the bent cable is below the minimum bending radius.



7.7.2 Buried 11kV XLPE 300mm² & 630mm² cables

The concept of section A can also be utilised for capped and buried 300mm² and 630mm² cables. The cable needs to be kept vertical in the caisson and cut just below the ground level. The caisson may need to be cut in half to facilitate the sealing and then zip tied together on completion of the capping.

7.7.3 Any XLPE 11kV cable end not terminated and not buried

Where any XLPE high voltage cable is coiled and capped and not buried, i.e. coiled at the top of a pole in readiness for outdoor terminations, steps 3 to 7 in section 7.7.1 above are to be carried out.

8. IDENTIFICATION OF CABLE PHASING

Underground LV an HV cables must be marked at each end with coloured PVC tape for phase identification as per the following table :

VOLTAGE	PHASE IDENTIFICATION AND COLOUR				
240/415 V	Red	White	Blue	Neutral No tape req'd	Equipment, fuse boxes etc
7.6 kV	A Red	B White	C Blue		
11 kV	G Red	H White	J Blue		* See note below table
33 kV	1 Red	2 White	3 Blue		

* 95 mm² bundled cables are marked with numbers for phase identification. No.1 is Red, No.2 is White and No.3 is Blue.

9. ACCESS PERMITS & CONNECTION TO ETSA UTILITIES EXISTING EQUIPMENT

Where cables are required to be terminated in existing ETSA Utilities equipment such as transformers, switching cubicles and on poles, ETSA Utilities will be responsible for the de-energising and isolation of all relevant points of infeed.

An Access Permit will be required by the Contractor before any work, access or close inspection within or near equipment, which is capable of being energised, see Appendix 1.

Prior to the commencement of construction, the Contractor shall obtain all Access Permit requirements for the project.

At the point of connection for an underground cable, unless otherwise specified, the following shall apply:

(a) On a stobie pole

The minimum work the contractor must undertake is to mount the cable on the pole as per the relevant E drawings including the installation of a cable guard when necessary. The coiled cable should be securely suspended utilising a section of flexible conduit around the cables to minimise damage to the outer sheaths. The bottom of the coil should be no less than 4 metres from the ground.

(b) Low voltage connection in an existing transformer

The cable termination should be completed and the connection bolted to the low voltage isolator. The neutral should be left off.

(c) High Voltage

Providing there is no exposed live components the termination can be undertaken and placed in the HV side of the vault in accordance with clause 7.6 above.

10. TEST RESULTS AND CHECK SHEETS

ETSA Utilities' Inspector shall have at all reasonable times access to the work site, and shall have the power at all reasonable times, to inspect, examine, and test materials and workmanship of the works during its manufacture or installation. ETSA Utilities' Inspector shall be notified ten working days prior to any final testing of cables.

Construction Checks are to be completed by the Contractor throughout the progress of the works. The Check Sheets shall be submitted with the Certificate of Practical Completion. Check Sheets shall be in accordance with Appendix 2.

Tests shall be performed and the results recorded in accordance with the Testing Standard (TS 105) and submitted with the Certificate of Practical Completion.

11. CABLE TESTING

Cables shall be tested in accordance with the Testing Standard for Underground Cable Networks TS 105.

12. COMPLIANCE WITH REGULATIONS

The use and maintenance of all plant, tools, gear, safety equipment and other appliances necessary or desirable for the full and proper performance of the works shall conform to the requirements of any applicable State or Local Regulations or Ordinances in the State of South Australia.

The Applicant shall ensure that Contractors and Subcontractors conform to the requirements of Acts of Parliament and all regulations, by-laws or orders made thereunder and to the requirements of Public Municipality and other Authorities and Australian Standards in any way affecting or applicable to the work.

13. EARTHING

13.1 General

All connections from the LV neutrals or the HV copper screen wires to the earth bar shall be made so that each connection may be disconnected without interference to the others.

3.0 metre earth electrodes and associated wiring shall be installed in accordance with Clause 6 and ETSA Utilities' URD Manual.

13.2. Earth Rod Installation

13.2.1 Mains Side Service Pillar Locations other than the last mains side pillar in each feeder

Earth rods shall be installed in ground in accordance with the following.

- (a) Drive a 3 metre rod which shall not be cut, to the depth required by the URD Manual. The rod need not be electrically tested; or
- (b) Drive a rod to a minimum depth of 1.0 metre in contact with final reinstated ground and in addition meet the earth stake resistance test requirement of not more than 30 ohms to remote earth.

13.2.2 Service Pillar Location at the last mains side position at the end of each feeder or Radial Road Crossings.

Earth rods shall be installed in ground in accordance with the following:

- (a) Drive a 3 metre rod which shall not be cut, to the depth required by the URD Manual. The rod need not be electrically tested; or
- (b) Drive a rod to a minimum depth of 1.0 metre in contact with ground and in addition meet the earth stake resistance test requirement of not more than 10 ohms to remote earth.

13.2.3 Installing earth rods external to the service pillar / pit

Install the earth stake 200 mm to the rear of the service pillar / pit and between the consumer's conduit. Connect to the neutral with green/yellow 50 mm² copper conductor.

13.2.4 Earth rod location

If an earth rod installation is in private property, it must be located within an ETSA Utilities' registered easement.

An exemption is an earth rod installation for a service pillar that does not require a registered easement.

Refer to E1905 for preferred locations.

13.3 Transformer and Switching Cubicle Locations

At transformer and switching cubicle locations, uncut rods shall be used.

Where rock is encountered and drilling is required, the rod shall be installed in accordance with the following:

- (a) Using a suitable tool, drill a hole between 50mm and 100mm in diameter.
- (b) If the earth rod forms part of a network, which will require electrical testing, a preliminary test shall be conducted on the drilling rig. This test will indicate if deeper drilling is required.
- (c) Prepare a slurry mixture of "Earthrite", Supply Item EK7430 with water in equal parts by weight and pour into the hole.
- (d) Install the earth rod in accordance with ETSA Utilities' URD Manual.
- (e) Top up the hole with Earthrite if necessary.

13.4 MEN Areas

The earthing networks at padmount transformers and 11kV switching cubicles in MEN areas shall be tested in accordance with drawing E1003 Sheet 3 of the URD Manual. The results of this test shall be reported in accordance with the Testing Standard (TS 105). Where additional earth electrodes are driven outside the transformer or switching cubicle vault, those electrodes and associated cable shall be shown on the "as constructed" drawings.

14. PUBLIC STREET LIGHTING

14.1 Footings

Packing sand shall be a non-plastic washed or unwashed pit, river or quarry material. Transport SA Specification PM 61, Sand, Type A. or equivalent is a suitable material.

The installation of footing caissons shall be in accordance with ETSA Utilities' URD Manual. and shall include:-

- (a) The preparation of the caisson by the boring of cable access holes when required by the drawings.
- (b) The setting of caisson footings in a permanent position by the placement of packing sand firmly around the outside of the footing caisson.
- (c) Placing prepared caissons in a vertical position, the positioning of cables, into bore holes prepared by the Applicant.
- (d) The permanent positioning of the footing caisson shall be made by the placement of packing sand firmly around the outside of the caisson.

14.2 Lighting Columns and Luminaries

The installation of lighting columns and luminaries shall be in accordance with ETSA Utilities' URD Manual and shall include the following:

- (a) The assembly of the sections of the lighting column when required.
- (b) The wiring and installation of fuse panels.
- (c) The placing and sanding of lighting columns into caisson footings.
- (d) The connection of the wiring from the supply point to the fuse panel within the lighting column.
- (e) The installation of the luminaries on the column
- (f) The connection of wiring from luminaries to the fuse panel.
- (g) The installation of lamp and photosensitive device.
- (h) Lighting columns shall be installed so that final position is vertical, with the column outreach at 90 degrees to the kerb.
- (i) The column access door shall be positioned away from the kerb or in a position such that a person working will be facing on-coming traffic.
- (j) Care shall be taken to ensure correct orientation of the luminaries refractor with respect to the road.
- (k) Marking of Columns
- (l) The Contractor shall be responsible for the marking of light column with numbers as issued by ETSA Utilities at the time the design drawings were reviewed. The specific requirements are as follows:
- (m) Stencils are to be used 40mm in height.
- (n) Numerals are to be placed vertically on the column, 1.5 metres above ground level and facing the roadway.
- (o) On galvanised columns, Black quick drying road marking paint shall be used.
- (p) On other columns, White quick drying road marking paint shall be used.
- (q) Details of the completed numbering shall be shown on the "as constructed" drawings.

15. INFORMATION TO BE PROVIDED

15.1 General (See also Electrical Design Standard TS 100)

ETSA Utilities requires a file in DXF format (CAD drawing) to form the basis of the "as constructed" record of the Development. The drawing file must be to a scale of 1:1000.

Applicants must carry out checks for computer viruses on data being supplied. Data found to contain a computer virus will not be accepted.

15.2 Cable Traceability

The Contractor shall record information on all LV and HV cables installed in the development, excluding cables used for earthing and public lighting circuits. The information shall be included with other information before ETSA Utilities accepts the Certificate of Practical Completion.

The information to be provided shall include the following:

ETSA UTILITIES URD Agreement Number			
Estate Name			
Estate Location			
LV Cables	Size (mm2)	Manufacturer	Drum Numbers
HV Cables	Size (mm2)	Manufacturer	Drum Numbers

Refer to TS-105 Appendix A – Form F44 to capture this data.

16. SAFETY

The Applicant shall ensure that the site conditions are not hazardous to the Contractor prior to the commencement of the Works.

Safety of Contractor's employees and the general public during the execution of contract work is the responsibility of the Contractor. In addition the Contractor shall ensure that its employees, who are to perform work or assist in the performance of work of any nature are adequately trained in the methods of rescue and resuscitation in conformity with recognised practices in the electricity supply industry and shall provide adequate training facilities for this purpose.

The Applicant shall ensure that Contractors and Subcontractors:

- (a) Are aware of and comply with Regulations under The Occupational Health Safety and Welfare Act 1986.
- (b) Comply with any safety requirement of ETSA Utilities in relation to work that involves existing ETSA Utilities equipment.
- (c) Undergo such induction training as required for work that relates to existing ETSA Utilities equipment.
- (d) On request, supply the ETSA Utilities representative with any certificate of compliance or testing of machinery and any licence or certificate of competency or operators as relevant.